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ADDRESS OF PRESIDENT COOLIDGE IN HONOR OF MR. EDISON[1]

A PERSON of high character and remarkable achievement holds a fascination for all mankind. It is literally true that the world will make a beaten path to his door. Such persons are the leaders who by their example and their wisdom stimulate their fellow men to better things and are in the main responsible for human progress. They are the pioneers in opening up new territory in our physical surroundings and in the domain of thought. Not only the United States, but other regions in the far-off ends of the earth are pausing to-night to pay their tribute of respect and reverence to such a figure, while he is still with us, in appreciation of what he has done to advance the cause of civilization.

The life of Thomas Alva Edison, master of applied science, has been represented as a romance. He has been called a genius, a wizard. While these terms may well be used to describe his great abilities, yet this remarkably modest man has constantly refused to attribute such qualities to himself. In his blunt and homely way he is quoted as having said that genius is made up of one per cent. inspiration and ninety-nine per cent. perspiration. Even if not literally true, this expresses an important idea, which he has not failed to apply. Carrying on the same thought he is said to have made an adaptation of the well-known maxim to the effect that everything comes to him who hustles while he waits. Rather than to any mysterious power, he attributes his success to intelligent and persistent hard work along the practical lines of applied science.

That Edison was endowed at birth with that rare intellect and wisdom given to those who have helped shape our destinies, few will deny. But, when asked on his seventy-seventh birthday for his philosophy of life, the reply was: "Work—bringing out the secrets of nature and applying them for the happiness of man." His goal always has been some useful objective. Rarely has he wasted his energies. Having carefully determined what needed to be accomplished, he has gone ahead with unerring instinct of a seeker after truth, with an indomitable spirit for accurate

[1] Made over the radio from Washington to the Menlo Park Laboratory and relayed to forty-eight stations on the occasion of the conferring of the Congressional Medal on Mr. Edison by Secretary Mellon on October 20.

research, with an infinite capacity for taking pains. Temporary failure has only spurred him to renewed activity. Few men have possessed to such a striking degree the blending of the imagination of the dreamer with the practical, driving force of the doer. In the record of his inventions and improvements rests the unimpeachable testimony that he has brought things to pass.

I have been interested in his account of a visit to the White House in 1878 to exhibit his newly developed phonograph. He relates that he came at 11 o'clock in the evening upon the invitation of President Hayes, who, with Mrs. Hayes and their guests, became so engrossed in the marvelous device that the inventor did not get away until 3:30 A. M. But we know that Edison has never made a practice of retiring early.

The field of electricity will be most closely associated in future years with the name of Edison. It has been asserted somewhere that there is scarcely an electrical process or instrument of to-day which does not reflect in some way changes wrought by his researches. Steinmetz, who should be an authority, said Edison had done more than any other man to promote the art and science of electrical engineering. In his invention of the incandescent lamp and in the perfection of means for developing and distributing electrical energy he literally brought light to the dark places of the earth. Through these and other products of his genius old industrial processes have been revolutionized, new ones developed, and our daily lives have been made easier, our homes pleasanter and more comfortable.

Although Edison belongs to the world, the United States takes pride in the thought that his rise from humble beginnings and his unceasing struggle to overcome the obstacles on the road to success well illustrate the spirit of our country. We are happy to share his achievements as our contribution to progress. He represents the finest traditions of our citizenship. At the request of the Secretary of the Navy in 1915 he became president of the Naval Consulting Board, which looked into inventions and devices designed to aid us in preparedness and later in our participation in the world war. From 1917 to 1919 his entire time was at the disposal of the government. Not only by his own discoveries, but by training in his laboratories men who have gone out to important places in the scientific and industrial world and by encouraging countless others to renewed efforts in applied science and invention, he has made a notable contribution to education.

This is my message to Mr. Edison: Noble, kindly servant of the United States and benefactor of mankind, may you long be spared to continue your work and to inspire those who will carry forward your torch.

THE HISTORY OF ELEMENTARY MATHEMATICS IN THE PLIMPTON LIBRARY[1]

When Christopher Plantin and his successor, John Moretus, sought to develop their great printing establishment at Antwerp in the sixteenth century, they collected a large number of specimens of the best medieval and Renaissance manuscripts and of representative products of the leading presses of Germany, France and Italy. This collection was increased by their successors and now forms one of the best libraries extant for the study of the history of bookmaking. Plantin felt that in order to be a master printer he must know thoroughly the history of his art. He wished to make the best books possible, and to do this he must know the best that had already been accomplished.

It was a similar circumstance that led me, fifty years ago, to begin collecting books for my own library. I am a publisher of text-books; my firm (Ginn and Company, of Boston, New York and London) seeks to make the best text-books possible, and I felt that, to do this, it was necessary to know thoroughly the historical development of books of this nature. I, therefore, began to collect such material, both in the manuscript form used in the Middle Ages and in the printed form beginning in the Renaissance period. As a result, my library covers the entire field of education, the mathematical text-books being merely one division, although one of the most important.

It is impossible, in the few minutes at my disposal, to do more than refer to a few of the important features of the section devoted to the early history of elementary mathematics. The subject was treated more than twenty years ago by Professor David Eugene Smith in his "Rara Arithmetica," and various references to my later acquisitions are mentioned in his "History of Mathematics" (1923, 1925). When the "Rara Arithmetica" was written he found that while DeMorgan was able to examine less than one hundred arithmetics printed before 1601, and while Boncampagni secured for his own great library less than three hundred, and Libri a still smaller number, my own collection was even then in excess of Boncampagni's, and in the last few years it has been very much enlarged.

Of the mathematical manuscripts in the library, something over one hundred, only a few of the most

[1] Address before the International Mathematical Association, at Bologna, Italy, on September 6, 1928.

important can be mentioned at this time. They are as follows:

(1) In Euclid's "Elements" the library is rich. It has the translation of Euclid by Campanus, directly from the Arabic manuscript, which Campanus presented to the Patriarch of Jerusalem, who afterwards became Pope Urban IV. He was Pope from 1261–1264. This is supposed to be the earliest known Latin manuscript, and it is written on vellum. The translation of the theorems is thought to be the same as that made by Adelard of Bath about 1120. He is supposed to have made a translation, but no copy is known.

(2) Another very interesting manuscript is dated 1294 and happens to be bound with the manuscript of Boethius. It seems to be complete and is fully illustrated.

(3) Euclid, fragment of the "Elements." Vellum, c. 1350.

(4) Euclid, the first five books of the "Elements." Paper, c. 1375.

(5) Euclid, Book I. Paper, c. 1460. German hand.

(6) Euclid, Books I–III. Manuscript, vellum, c. 1500, being Zamberto's translation from the Greek, manuscript of Theon. The translation was printed in 1505 (Venice).

(7) Gerbert (Sylvester II). Manuscript copy on paper, c. 1600. It includes his geometry.

(8) Boethius, "Arithmetica." Manuscript, vellum, tenth century.

(9) Boethius, "Arithmetica." Manuscript, vellum, c. 1294.

(10) Boethius, "Arithmetica." Manuscript, vellum, c. 1300.

(11) Boethius, fragment of "De Musica." Vellum, c. 1300.

Arithmetic based largely on Nicomachus who lived 100 A.D. He gives elaborate theory of ratios and devotes considerable attention to figure numbers such as the triangular, square pantagnal and cubic. It was the standard of church schools throughout the Middle Ages.

(12) Mohammed ibn Musa, Algebra. Manuscript, paper, 1456. So far as is known this manuscript has never been published. It differs in many particulars from the Robert of Chester Manuscript.

(13) Venerable Bede (673–735). Manuscript, vellum, written in 1129 and stated by the scribe to have been copied from Bede's own manuscript. An unusually well-written and carefully preserved manuscript. Treats of the division of time, finding of Easter, division of months and their names in Anglo-Saxon. Burke calls him the father of English learning.

There is also an early fifteenth century English language manuscript on arithmetic that has the four subjects of addition, subtraction, multiplication and division.

A rather interesting anonymous manuscript of about 1565 was written right here in Bologna. It opens with a set of column multiplication tables.

(14) Isidorus of Seville, born 570; died 636, "Etymologies." Manuscript on vellum, twelfth century. The library also has the early printed editions of the work. The third one of twenty books is on mathematics. The manuscript is a sort of encyclopedia. The Council of Toledo designated him as the "most learned man of the ages."

(15) Anianus, "Computus Manualis." Manuscript on paper, bearing the date 1384 and written about that time. Important as being apparently the oldest manuscript of this work that can be rather definitely dated. The library contains a considerable number of the early printed editions, including what seems to be a unique copy of the Poitiers edition of 1527–1528, as shown in Professor Smith's recent (1928) bibliography of this notable work.

(16) Paolo Dagomari. Paolo dell'Abaco, Paolo Astrologo, Paolo Geometra, Paolo Arismetra, Paul of the Abacus. He was born in Prato in 1281 and died at Florence in 1374. The manuscript was written about 1339. It is primarily a treatise on arithmetic. Part of this manuscript is an ordinary commercial arithmetic such as the Florentine teacher used in the fourteenth and fifteenth centuries. It is interesting as showing some tendency towards the use of percentage.

(17) This manuscript of Albertus Magnus was written about 1350. He was called *Doctor Universalis*. The first folio contains part of the calendar, and a few random memoranda, including an old price mark of three ducats.

(18) Giovanni, son of Luca of Florence, "Trattato di Arithmetica." Manuscript, paper, 1492. One of the best sources for the history of commercial arithmetic of the fifteenth century.

(19) Benedict of Florence. "Trattato d'Arimetricha." Manuscript on vellum, c. 1460. Also an excellent source for the study of arithmetic at that period. Here are the problems, grain of wheat on chessboard; hare and hound; jealous husband; testament of the dying man.

(20) In my collection there is a manuscript by Rollandus, who was a native of Lisbon and canon of Sainte-Chapelle, Paris, in 1425. The date of this manuscript is 1424. It was prepared at the command of John of Lancaster, Duke of Bedford, son of Henry IV of England, at one time Protector of England and Regent of France. Rollandus dedicated this treatise

to him. It is a long dedication and sets forth Lancaster's interest in France and the status of mathematics at that time. In his manuscript Rollandus covers all the theoretical arithmetic then known, but takes up no practical problems. He treats of irrational numbers, a topic which is now considered algebra. It is doubtful whether there is a manuscript extant which throws more light upon the nature of French university mathematics at the time this was written.

In addition to the manuscripts already mentioned there are many others of equal importance. These relate to arithmetic, algebra, geometry and astronomy and include works of such men as Joannes de Gmunden, Sacrobosco, Bradwardin, Raymond Lullius, Vergerius, Johannes Ross, Leonardo of Pisa (extracts), Nicolo de Orbelli, Canacci and Leonardus Maynardus.

Now when we come to the printed books that deal with these subjects, the library has the first arithmetic printed at a small town called Treviso, in Italy, in the year 1478. There are in all, perfect and imperfect, 6 or 7 copies known. This work is commercial in character—the fundamental processes being taken up in common order and followed by the rule of three. It has the calendar for church purposes. The book contains the mathematics necessary for business requirements and uses Hindu-Arabic numerals.

There is also the first printed edition of Isidorus of Seville, supposed to have been printed about 1469. The date is uncertain. It is a book of etymologies. We have already spoken about his manuscript. This is the first authority we have on the learning of that period. We do not call this the first printed arithmetic because it has other chapters besides arithmetic; in fact, as I have said before, it is a sort of encyclopedia of that time.

In addition to this one, I have another very interesting first edition of the Tractatus Proportionum by Albert of Saxony, which was printed about 1478.

The mathematical activity in Italy during this period between 1472 and 1480 was very considerable. During this time there were thirty-eight mathematical works printed in the country. In the next decade there were sixty-two and in the next one hundred, with thirteen of uncertain date between 1472 and 1500, making a total of two hundred and thirteen appearing in a period of less than thirty years.

In 1480 an anonymous work was issued from the Caxton press in London, entitled "The Mirrour of the World or Thymage of the Same." This has the first chapter on arithmetic.

Here is the first commercial arithmetic ever printed. It is by Giorgio Chiarini, 1481. While this is not strictly speaking an arithmetic, it is the first printed book to give the customs relating to exchange in use among the Florentine merchants at the close of the fifteenth century. It is the source from which several later writers drew their material and is particularly valuable in showing the nature of the practical problems of the time. Copies of this first edition are extremely rare.

Prosdocimo de Beldamandi, and Liverius. First edition, 1483. Prosdocimo de Beldamandi was born in Padua about 1370 and died about 1428. He was educated at the University of Padua and also taught there. He wrote on arithmetic, music and astronomy. This book was written for the Latin schools and is a good example, the first to appear in print, of the non-commercial algorisms of the fifteenth century.

Pietro Borghi, first edition, 1484. Borghi, a Venetian arithmetician, died about 1494. This is the first edition which I have, and it is really the second treatise on commercial arithmetic to be printed in Italy. This is much more elaborate than the Treviso Arithmetic. Moreover, it set the standard for arithmetic in the early centuries, and none of the early text-books deserves more careful study. He pays considerable attention to the rule of three, which was developed many centuries earlier by the Oriental mathematicians, and was not improbably learned by the Venetian traders through their contact with the East. Partnership was to the fifteenth what the corporation is to the twentieth century. The subject of barter is treated more or less and was common in our own American text-books until about fifty years ago. The library is especially rich in different editions of this.

I have an interesting early printed book on "Ars Numerandi." Many have questioned whether it was not printed by Fust and Schoeffer, about 1470. This is a treatise on grammatical usage as applied to numbers, and a considerable portion of the text is devoted to the distinction between ordinals and cardinals and the methods of using them.

There is also the first edition of the Boethius Arithmetic, printed at Augsburg in 1488. The library is particularly rich in editions of the Boethius books.

It also has the first printed edition of Anianus and Johannes Sacrobosco, Strasburg, 1488. Anianus was a fifteenth century astronomer and poet of Strasburg, and Sacrobosco was born in Halifax, Yorkshire, and died in Paris in 1244 or 1256. Sacrobosco wrote on astronomy and algorisms. In the book of Anianus appears for the first time in print: "Thirty days hath September," etc. This probably is also the first book on mathematics printed in Strasburg. There are a great many different editions of Anianus as well as Sacrobosco.

The library possesses also the first book printed in Germany on arithmetic by Johann Widman. Widman was born in Bohemia, in 1460, and was educated at Leipzig. The interesting feature about this book, the first printed work on calculation by the aid of counters, is that it contains the device of Martin of Würzburg and was probably printed by him about 1488. After a brief introduction on the use of counters, he takes up the subjects of division, subtraction, multiplication, progression, etc. There are many different editions of Widman in my library.

Another rare and interesting book is that of Philippi Calandri, which was printed in Florence in 1491. This is the first arithmetic with illustrations. My library happens to have two copies of this. I found this on a book-stall in Rome and paid one lira for it.

One of the rarest of the early printed books is that of Francesco Pellos or Pellizzati, Turin, 1492. Pellos was a native of Nice. Pellos first considers the fundamental operations with integers, following this by a treatment of proportion, square root and cube root. He then discusses the subject of fractions in much the same order, the rule of three, certain rules relating to weights, time, money and other measures and such topics as partnerships, barter, interest, alloys and the rule of false position, single and double. He closes the work with a chapter on mensuration, or as he calls it, "De la art de jeumentria," and gives a number of interesting woodcuts. The chief interest of the book attaches, however, to the fact that Pellos came very near the invention of decimal fractions, and that he actually used the decimal point. It can not be said, however, that he had any conception of the real value of the decimal fraction as such; Pellos simply used the decimal point to indicate division by some power of ten, writing a common fraction in the quotient. Thus, to divide 425 by 70, Pellos would divide 42.5 by 7, writing the result 6 5/70. Professor David Eugene Smith first discovered this book, and always takes a great deal of interest in saying that I paid for it as many dollars as there are days in the year.

The library has also the first edition of Luca Paciuolo, "De Borgo San Sepolcro." This has arithmetic, algebra and geometry, being treated largely from the scientific rather than from the practical standpoint. Here is included an interesting chapter on finger symbolism. The arithmetic, for example, gives the various methods in multiplication and division, instead of emphasizing the one or two most prominent in business circles. In the same way Paciuolo's treatment of the rule of three, the rule of false position (el cataym), partnership, pasturage, barter, exchange and interest, while nominally practical, was too elaborate for the mercantile schools. His was the first printed work to illustrate the finger symbolism of number.

Thomas Bradwardin, first edition, 1495. Bradwardin, Archbishop of Canterbury, was a professor of theology at Oxford. He was the first really great mathematician after Beda and wrote four different works on arithmetic, largely based on the theory of numbers.

Martianus Mineus Felix Capella, first edition, 1499. Capella was born at Carthage about 1475 and lived in Rome. This work is more or less an encyclopedia and treats of the various classes of numbers, such as plane and solid. It is one of the great text-books of the Middle Ages.

Gregorius Reisch, "Margarita Philosophica," first edition, 1503. Reisch was born in Württemberg, and died in Freiburg, 1523. He was a Carthusian monk and was prior of the cloister at Freiburg. This is a sort of encyclopedia, also. It contains a compendium of the trivium, the quadrivium and the natural and moral sciences. It is made up of twelve books. The arithmetic closes with a treatment of line reckoning, giving the four fundamental operations and the rule of three.

The first edition of Juan de Ortega (1512), a Spanish priest of the Dominican order in Aragon. This arithmetic was one of the most celebrated written in Spain in the sixteenth century. It is a purely commercial text, beginning with notation, taking up the four processes with integers, the progressions, the roots and the checks on operations and the same operations in the same order with fractions, and then discussing the business rules. There are several editions of it in my library.

An interesting arithmetic is that by Jacob Köbel, first edition, 1514. Köbel was born at Heidelberg in 1470 and died in 1533. He studied at Cracow, and one of his fellow pupils was Copernicus. This book appeared under very many different titles. It was a celebrated work and became a very famous arithmetic.

I have a number of arithmetics by Girolamo and Giannantonio Tagliente, the first edition of which was issued in 1515. The work opens with a brief statement of notation and finger symbols, followed by the multiplication table, the proof of sevens, various methods of multiplication, division by the galley method, addition chiefly by denominate numbers, subtraction, the operations with fractions in the same order, exchange, rule of three and applied problems. There are very few arithmetics that have exerted the influence that this did in the shaping of subsequent arithmetics.

I have a very interesting collection of various authors, bound in one volume—Joannes De Muris (born in Normandy, 1310; died in 1360); Thomas Bradwardin, about whom I have already spoken; Nicolaus Horem (born at Caen, 1323; died in 1382); Georg Von Peurbach (born, 1423; died, 1461), and Johannes de Gmunden (born, 1380; died in 1442)—dated 1515. The work consists of five parts.

The library contains the first edition of Gaspar-Lax (1515), who was born in Spain in 1487 and died at Saragossa in 1560. He was a famous teacher in Paris and Saragossa. His book is largely theoretical arithmetic, based on Boethius and his medieval successors.

Henricus Grammateus. First edition in 1518. This book is really a mercantile arithmetic, and the operations are both according to the abacus and by Hindu-Arabic numerals. It has a chapter on bookkeeping, and gives a good deal of consideration to the theory of numbers, the rules of the Coss (algebra), music, bookkeeping and gauging. The signs "plus" and "minus" are here first found in the rule of false position. He differs from Widman in that he uses them for a different purpose.

Estienne de la Roche. First edition, 1520. This is really the best of all the early French arithmetics, and is semi-mercantile in character. Here is a very complete treatment of the operations with integers, fractions and compound numbers, and a large number of business applications. Much of his work, however, is taken from his teacher, Chuquet. I have several editions of this.

I have the first arithmetic printed in England by Cuthbert Tonstall, 1522. Tonstall was born at Hackforth, Yorkshire, in 1474, and died in 1559. He was educated at Oxford, Cambridge and Padua. He was bishop of London, and later of Durham. His object in writing the book, he said, was to check certain goldsmiths whose accounts he suspected were incorrect. It is in Latin, but is based largely on Italian models, and includes many business applications such as partnership, profit and loss and exchange. He dedicates the book to his friend, Sir Thomas More. More speaks of Tonstall in the opening lines of his "Utopia":

> I was colleague and companion to that incomparable man Cuthbert Tonstall, whom the king with such universal applause lately made Master of the Rolls: but of whom I will say nothing; not because I fear that the testimony of a friend will be suspected, but rather because his learning and virtues are too great for me to do them justice, and so well known, that they need not my commendation unless I would, according to the proverb, "Show the sun with a lanthorn."

The "Utopia" was first printed in 1516, so this sonorous praise was written some years before Tonstall's arithmetic appeared.

There was also the arithmetic of Adam Riese, first edition, 1522. Riese was born in 1489, and died in 1559. He was one of the most celebrated of the mathematical teachers of the sixteenth century. So firmly did he impress himself upon the schools that *nach Adam Riese* is a common expression in Germany to-day. His books were to Germany what Borghi's book was to Italy, and what Recorde's was to England. The library has most of the many editions of Adam Riese.

It has also the first edition of *Orontius Finaeus*, 1530–1532. He was supposed to be the most pretentious French mathematician of his time. The library has a great many different editions of this.

I have also several editions of Michael Psellus, 1532. He was one of the last Greek writers on arithmetic, and his work was largely devoted to the theory of numbers. It covers the medieval Quadrivium—arithmetic, music, geometry and astronomy.

Then I have the first edition of Nicomachus, 1538, which is the most celebrated of the few Greek treatises upon the subject. Nicomachus was born 100 A.D. He tried to do for the Greek theory of numbers what Euclid did for geometry.

Gemma Frisius, first edition, 1540. I have many different editions of this, which was one of the most popular arithmetics of Germany in the sixteenth century. It combined the older science of numbers with commercial arithmetic, so that it appealed remarkably to the teachers of that time.

The library has numerous editions of Robert Recorde, the first noteworthy arithmetic printed in the English language, 1542. Recorde was born about 1510 and probably died about 1558. He was educated at Oxford and Cambridge. The arithmetic was in the form of a dialogue between master and student. The student thinks the study of number is useless and vain, that people can get along just as well without it and that hence it is a waste of time. The master replies:

> If number were so vile a thing as you did esteem it, then need it not be used so much in men's communication. Exclude number, and answer to this question, "How many years old are you?"
>
> "Mum," the student replies.
>
> "How many days in a week?" "How many weeks in a year?" "What land has your father?" "How many men doth he keep?" "How long is it since you came from him to me?"
>
> "Mum," answers the student.
>
> "So that if number want, you answer all by mummes."

Michael Stifel, "Arithmetic," 1544. Stifel was reformer and one of the most skilful arithmeticians of his time. The library has several editions of his books.

Johann Scheubel, first edition, 1545. Scheubel was born in 1494 and died in 1570. He was professor of mathematics at Tübingen. He wrote on arithmetic and algebra, and edited part of Euclid.

I have also the first edition of the rare Spanish arithmetic by Gaspard de Texeda, 1546. Here the fundamental processes with integers, fractions and denominate numbers are given.

Nicolo Tartaglia, "General Trattato," first edition, 1556. Tartaglia was born at Brescia in 1506 and died at Venice in 1559. He was one of the best mathematicians of his time, and his connection with the general solution of the cubic equation is well known.

Iean Trenchant, first edition, 1566. One of the best of the sixteenth century text-book makers of commercial arithmetics in France. The book was divided into three parts, the first dealing with the fundamental operations with integers and fractions; the second treats of the rule of three in its various forms; and the third treats of the properties of numbers, including figurate roots and progressions, and has some work on discount.

The second important arithmetic printed in the English language was by Humphrey Baker, 1568. It is called "The Well Spring of Sciences, which teacheth the perfect worke and practise of Arithmeticke, both in whole Numbers and Fractions." Baker's work was a rival to Robert Recorde's "Ground of Artes." He has chapters on merchandise, fellowship, barter, alligation, false position and the like.

A rather interesting edition of Petrus Ramus's Arithmetic, which has on the title page in the handwriting of the author the inscription, giving it to his pupil Johannes Sturm, the famous German scholar.

Another interesting arithmetic is that by Leonard and Thomas Digges, first edition, 1572. There are only about twenty pages that are arithmetic. Then follows a brief treatment of algebra, after which are certain matters relating to military affairs. Leonard Digges was born at Barham, Kent, and studied at Oxford. He died in 1571. Thomas was a son of Leonard, and was also born in Kent and educated at Oxford. He died in 1595.

There was a very interesting arithmetic by Thomas Masterson, London, 1592. This book, however, does not make any particular contribution to the subject of arithmetic. Book I is on the fundamental operations with integers and fractions; Book II is a collection of practical problems representing the mercantile activities of London; and Book III refers chiefly to irrational numbers, which would now be considered algebra.

Frisius, Cardan, Trenchant and Bombelli, of the seventeenth and eighteenth century writers, the most important ones, judged from the standpoint of their text-books, are generally included. There are first editions of most of their works, but the list is too long to be given at this time.

The library has always been open freely to scholars, and for many years it has been used by them in the preparation of theses and of books.

I am often asked what my plans are for the future of this library, and the matter is so important for students of the history of mathematics that the question deserves a reply. I do not believe that it is for the best interests of the world, at least for the United States, that such libraries as are now in my country should be dispersed. Collectors and booksellers may wish them to go to the auction rooms, but it seems to me that a library like mine should be kept intact for the use of scholars. This I propose shall be done in this case, provision being made for its preservation and growth in one of our large universities.

GEORGE A. PLIMPTON

NEW YORK, N. Y.

ANDREW HENRY PATTERSON
1870–1928

As a result of the death on September 9 of Andrew Henry Patterson, dean of the University of North Carolina's School of Applied Science and professor of physics, the South has lost one of its ablest educators and men of science.

Dr. Patterson was born September 28, 1870, at Winston-Salem, North Carolina. He received a liberal education in the arts and sciences, taking his Ph.B. and a B.E. at the University of North Carolina in 1891. In order to broaden his scientific education he entered Harvard, at which institution he took his A.B. in 1892, remaining there the following year for his M.A., with a thesis on "High Tension Phenomena."

The next year found him as a student engineer and electrician with the Consolidated Traction Co., of New Jersey, whence he joined the faculty of the University of Georgia as instructor of physics, thus reverting to his original plans for which his education had best fitted him. His success as a teacher was at once recognized by his promotion to an adjunct professorship in 1897 and to professor of physics in 1898.

His first sabbatical leave in 1905 was spent at Berlin and at the Charlottenburg Technische Hochschule, where he devoted himself to the study of electrical engineering.

He was called to the University of North Carolina as professor of physics in 1908 and was appointed dean of the School of Applied Science in 1911.

Dr. Patterson's training and experience were broad and his interests were many. He wrote many essays on cultural, educational and scientific subjects. He was an acute thinker and a most delightful teacher. His gentleness and sincerity, his readiness to give aid, his sympathetic and appreciative nature endeared him to his colleagues and students.

He was a fellow of the American Association for the Advancement of Science, the American Physical Society and a member of the North Carolina Academy of Science. He served at various times as president of the Elisha Mitchell Scientific Society and of the North Carolina Academy of Science (1919).

The University of Georgia conferred the doctorate of science on him *pro honoris causa* in recognition of his educational and scientific work.

His best known contributions covered the fields of X-rays, high tension phenomena, lightning discharges and atomic structure.

He is survived by his wife, Eleanor Alexander Patterson; his daughter, Mrs. Samuel J. Fisher, of Asheville, and his son, Dr. Howard Alexander Patterson, just entering the practice of surgery in New York, and four brothers—Frank Patterson, editor of the Baltimore *Sun;* Rufus L. Patterson and Edmund V. Patterson, of New York, and John L. Patterson, of Richmond, Virginia.

OTTO STUHLMAN, JR.
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SCIENTIFIC EVENTS

BIOLOGICAL FARM OF THE WISTAR INSTITUTE

FACILITIES for biological research at The Wistar Institute have been recently increased by the acquisition of an additional research foundation consisting of a farm of 150 acres, situated in a quiet region of the country in Bucks County, Pennsylvania, between Philadelphia and Trenton, twenty-seven miles from the institute's present museum and laboratory buildings in Philadelphia.

This farm, with a modern equipment of farm buildings, machinery, live stock and other essentials, is the gift of Effingham B. Morris, LL.D., president of The Wistar Institute. It comprises about one third of an original grant under patent from William Penn. Mr. Morris now represents the seventh generation in the course of its inherited ownership, and he will continue to farm the two thirds of the acreage retained by him.

In the deed of gift, dated August 11, 1928, establishing the Farm Foundation, Mr. Morris expresses in liberal terms his desire to aid in promoting the research work of The Wistar Institute, as established and conducted under the deeds of gift of General Isaac J. Wistar, who was his kinsman.

The necessary laboratory facilities for experimental work with mammals and other organisms will be provided. Colonies of several species of small mammals for research purposes will be maintained on the farm. Studies will probably be extended to other animals, especially such domestic animals as cattle, horses, sheep, hogs, dogs and poultry.

By the provisions of Mr. Morris's deed of gift, the study of living forms will not be confined to animal life; but, following the modern trend of biological research, opportunities will be afforded for the study of both animal and plant life. Facilities for the study of fresh-water aquatic forms will be unusual.

While the initial equipment for work will not be pretentious, at the same time it will be modern in every respect and subject to such growth and development as the work may indicate. Mr. Morris has made a cash contribution toward these initial expenditures. This farm will be known as "The Effingham B. Morris Biological Farm of The Wistar Institute of Anatomy and Biology."

One of the advantages of the location is the isolation from noise and other physical disturbances. Living accommodations for investigators with families can be arranged for in the neighborhood; and it is hoped that in due course the old Colonial red-and-black-brick farmhouse on the property can be arranged for use as a residence club house for men who wish to remain on the farm continuously during the periods of their investigations. It is expected that the farm will be ready for initial use early in the spring of 1929.

THE ABBE MEMORIAL MUSEUM AT BAR HARBOR

ON Tuesday, August 14, 1928, the Abbe Memorial Museum was dedicated in the presence of some hundreds of persons. There were three short addresses. The Honorable L. B. Deasy, lifetime friend of Dr. Abbe and treasurer of the museum corporation, a permanent resident of Bar Harbor, accepted the museum on behalf of the citizens of Mount Desert Island. The Right Reverend William Lawrence, Bishop of Massachusetts, paid high tribute to the life and character of Dr. Robert Abbe. Dr. Warren K. Moorehead described briefly the life of the aboriginal inhabitants of Mount Desert, contrasting the past with the present.

At the conclusion of the speeches a bugler stationed by the famous Sieur de Monts spring sounded taps, and another bugler far up on the mountainside echoed taps.

The late Dr. Robert Abbe was a famous surgeon of New York City. The last three or four years of his life he became much interested in the American Indian, particularly of the Mount Desert region.

Dr. Abbe cooperated with Mr. George B. Dorr, superintendent of the Lafayette National Park, Mr. John D. Rockefeller, Jr., Mr. and Mrs. Walter G. Ladd, Miss Carpenter, Miss Moon and many other summer residents of Bar Harbor in making possible the museum. It was first called the Lafayette National Park Museum of Stone Age Antiquities, but by common consent the title has been changed to the Robert Abbe Memorial Museum.

The setting is at the foot of Flying Squadron Mountain, and is distant five hundred feet from Sieur de Monts spring. The style of architecture is a modification of the Italian. The building is stucco and white stone, with red tile roof. From the building radiate various trails, and above towers the mountain. When the building was dedicated in August, it was the consensus of opinion that the site selected by Dr. Abbe and his associates was unequaled in scenic beauty.

The interior of the museum itself is of great simplicity and dignity, the space enclosed not more than twenty by thirty-five feet, since it was the purpose of the directors to establish what might be termed a trailside museum.

On the walls are hung relief maps made by Dr. Abbe himself, who was not merely a surgeon, but a sculptor and artist as well. These maps present the topography and geology of the Mount Desert region, the voyage of Champlain and the early settlements. Later there is to be added the chief Indian villages.

The collections are restricted to some three thousand objects illustrating the life of the prehistoric rather than the later Indians, and are confined to objects found within fifty miles of Bar Harbor.

The museum is to be open from the first of June until the first of October each year, and will be guarded during the winter by the Park Service.

From the day of opening until the end of September the average attendance has been over two hundred persons during week-days, and from five hundred to eight hundred on Sundays.

The writer had charge of the installation and field work the past summer, and eight miles north of the museum discovered a large kitchen midden very rich in bone harpoons, knife handles, knives and various stone objects. Eight hundred of these specimens were placed in a case by themselves as a special exhibit illustrating the life of the people of one site.

WARREN K. MOOREHEAD

PHILLIPS ACADEMY,
ANDOVER, MASS.

THE BOND ASTRONOMICAL CLUB

AN opportunity for any one seriously interested in astronomy to take part in scientific investigations is opened through plans developed at the recent meeting of the Bond Astronomical Club at the Harvard Observatory. The would-be investigators will be able to work under competent leadership in one or more of five different research groups, dealing with the study of meteors, the photography of stars and other celestial phenomena, the investigation of variable stars on plates in the Harvard collection, the computation of the position and motion of the moon, and certain historical and bibliographic studies.

The Bond Astronomical Club, founded four years ago to bring together the professional and amateur astronomers of the community, as well as the astronomically interested public, has in the past confined its activities mainly to monthly meetings at the observatory and to the conducting of two series of "Open Nights," one for Cambridge school children and the other for the public. A meeting place and telescopic facilities have been placed at the disposal of the club by the Harvard Observatory. More than a thousand pupils of the seventh and eighth grades of the Cambridge public schools visited the observatory last year under the guidance of their teachers to hear short illustrated talks on astronomy and to look at moon, stars or planets through some of the observatory's telescopes.

To assist in the new club activity, members of the observatory staff now volunteer to act as leaders of study groups so that volunteer workers with scientific interests may have an opportunity to develop a useful scientific hobby and do practical and scientific investigation on one or two or more evenings a month. Membership in the Bond Club and in the study groups is open to any one seriously interested in the work.

The group of workers on variable stars will have access to the great Harvard collection of stellar photographs and will study the variations and discover the nature of the remarkable reddish stars that appear to stand at the very dawn of stellar evolution. For many years amateur astronomers all over the world, under the guidance of the Harvard Observatory, have successfully observed these stars visually, with their own telescopes; but this is the first opportunity ever offered for the amateur to learn the art of making the still more useful photographic observations.

One of the subjects to which the club will devote particular attention for the next month will be the coming annual shower of shooting stars in the middle of November. The most important and spectacular meteor displays of this generation will probably be these November showers during the next few years.

The following officers were elected for the ensuing year: *President,* Dr. Harlow Shapley, director of the Harvard Observatory; *Vice-president,* Professor Lewis A. Brigham, Boston University; *Secretary,* Mr. Frank S. Hogg, Harvard Observatory; *Treasurer,* Mr. Freeman D. Miller, Winchester; *Councillors,* Mr. Percy Witherell, Jamaica Plain; Mr. Horace Taylor, Cambridge; Mrs. Eleanor Ingelfinger, Swampscott.

THE RUMFORD FUND

FOR nearly one hundred years the American Academy of Arts and Sciences has maintained a standing committee of seven persons, called the Rumford Committee. This committee receives and deals with applications for grants of money in aid of researches in light and heat, branches of science in which the founder, Benjamin Count Rumford, was particularly interested. Since 1839, the American Academy, through its Rumford Committee, has made 270 grants of this character, in sums between $25 and $750, averaging about $260.

Applications may be accepted from any duly qualified resident of North America or of the American islands. Applications should indicate the nature of the research and the particular aid sought. Grants may be applied to furnishing apparatus which remains the property of the academy, or to the printing and publishing of the results; but are not applicable to assistants. The research subjects within the scope of the fund are light and heat, including X-rays. Applications should be addressed to the Rumford Committee, American Academy of Arts and Sciences, Boston.

A. E. KENNELLY,
Chairman

CONFERRING OF THE CONGRESSIONAL MEDAL ON MR. EDISON

MR. THOMAS A. EDISON received on October 20 from Mr. Andrew W. Mellon, Secretary of the Treasury, the medal conferred on him by act of the Congress. The address was made by President Coolidge over the radio as given on page 389. In concluding his address in presenting the medal Secretary Mellon said:

It is that genius which has made possible the achievements of Thomas A. Edison. It has set him apart as one of the few men who have changed the current of modern life and set it flowing in new channels. Such men appear only at rare intervals in the world's history. They belong to no nation, for their fame, no less than their achievements, transcends national boundaries. America is proud that she has given such a man to the world and, as an expression of what the nation feels, Congress has directed that a gold medal be struck in commemoration of what Thomas A. Edison has done in illuminating the path of progress through the development and application of inventions that have revolutionized civilization in the last century. It is my privilege, Mr. Edison, to present to you this medal as a token of the high esteem and grateful appreciation of your country.

On receiving the medal from Secretary Mellon, Mr. Edison responded as follows:

Mr. President, Mr. Secretary and honored guests—in accepting the medal which has been awarded to me, I do so with a keen appreciation of the great honor that has been conferred on me. To my mind there is a profound significance in this token of the esteem and good-will of my fellow countrymen as expressed by their representatives in Congress. This medal will be a source of pride and veneration to my family as well as to myself and will be preserved in my home with my choicest possessions.

For the occasion the British government returned to Mr. Edison the first talking machine, which was loaned to the British Patent Office Museum forty-five years ago.

The concluding address was made by President John Grier Hibben, president of Princeton University.

SCIENTIFIC NOTES AND NEWS

A MONUMENT in honor of Joseph Henry was unveiled in Albany on October 18 at the time of the annual convocation of the University of the State of New York. The presentation to the city was made by William Gorham Rice, vice-president of the Albany Institute of History and Art. It was accepted by Mayor John Boyd Thatcher, 2d. Professor Islay F. McCormick, head master of the Albany Academy, spoke in appreciation of the monument having been placed in front of the academy where Henry carried out his experiments on the electromagnet. Dr. John H. Finley, of the New York *Times,* formerly New York State Commissioner of Education, made the principal address.

A DIPLOMA of membership in the Berlin Geographical Society was presented on October 14 to Dr. C. F. Marbut, chief of soil survey, U. S. Department of Agriculture. The presentation was made in Washington by Professor A. Penck, president of the society. Dr. Marbut was elected a corresponding member of the society at its centenary meeting some months ago.

THE Grasselli Medal Committee of the Society of Chemical Industry has voted to award the Grasselli Medal for 1928 to Dr. H. J. Rose for his paper on the "Importance of Coal Preparation in the Manufacture of Gas and Coke." This medal is awarded

for a paper presented before any meeting in which the Society of Chemical Industry has participated in the preceding five years.

MRS. ZELIA NUTTALL has been elected a corresponding member of the Geographical Society of Lima, Peru, in recognition, a correspondent writes, "of her having demonstrated that the inhabitants of tropical America dated the beginning of their solar year from the moment when the sun passed the zenith—which has led to the revival of the observation of this phenomenon as a school festival throughout Mexico and, under the patronage of the Geographical Society of Lima, is also to be instituted as a national festival for children throughout Peru."

DR. LEVADITI, of the Institut Pasteur, Paris, has been elected a member of the Paris Academy of Medicine.

DR. W. F. FOSHAG, of the division of mineralogy of the U. S. National Museum, has been made a corresponding member of the Sociedad Científica "Antonio Alzate" of Mexico.

JOHN HAYS HAMMOND has been elected to honorary membership in the Institute of Mining and Metallurgical Engineers, of which he has been a member of long standing and one of the past presidents, not of the American Society of Mechanical Engineers, as was erroneously reported in SCIENCE last week.

THE "Order of Merit in Culture" has been established in Japan. It will be conferred on "those who distinguish themselves in literary work or art, or who achieve merit in connection with the progress of human culture and social welfare." During the present emperor's coronation ceremony, to be held in November, the decoration will be conferred, for the first time, on Dr. Shiga, the discoverer of the dysentery bacillus, and on Dr. Inada, the discoverer of *Spirochaeta icterohemorrhagica*.

MAJOR LEONARD DARWIN, on his retirement from the presidency of the British Eugenics Society, was presented with his portrait by fellows and members of the society on October 10.

THE retirement of Dr. George M. Kober, after twenty-seven years' service as dean of Georgetown University School of Medicine, Washington, is announced. In accepting his resignation President Nevils tendered Dr. Kober a place on the board of regents of the university and the title of dean emeritus of the medical school.

N. ERNEST DORSEY, associate editor of *The International Critical Tables of Numerical Data*, has been appointed principal consulting scientist (physics) in the Bureau of Standards.

DEAN ALBERT R. MANN, of the New York State College of Agriculture, has been named director of the Agricultural Experiment Station at Ithaca. He will continue to serve as dean of the College of Agriculture.

B. J. HOWARD, microanalyst in the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, has been placed in charge of a microanalytical laboratory established in the Food, Drug and Insecticide Administration.

AT the Porto Rico Insular Experiment Station Dr. Melville T. Cook, acting director for several months, has been appointed vice-director and editor of the *Journal of the Department of Agriculture*.

HOWARD D. LIGHTBODY, associate professor of physiologic chemistry, Michigan State College of Agriculture, East Lansing, has been appointed director of the John C. Oliver Memorial Research Foundation, recently established at the St. Margaret Memorial Hospital, Pittsburgh.

DR. LINSLY R. WILLIAMS, who has been managing director of the National Tuberculosis Association since 1922, has resigned, and Dr. Kendall Emerson, of Worcester, Massachusetts, has been appointed as his successor.

DR. ROGER I. LEE, professor of hygiene of Harvard University Medical School, has been made chairman for this year of the committee on public health of the Boston Chamber of Commerce.

DR. LUDWIG STEINER has been appointed director of the Hungarian Institute for Meteorology and Magnetism at Budapest.

DR. WILLIAM H. MCGOVERN, assistant curator of South American ethnology at the Field Museum of Natural History, Chicago, resigned on October 1.

DR. GREGORY BREIT, mathematical physicist of the department of terrestrial magnetism of the Carnegie Institution, has been assigned to carry out work in atomic physics in various laboratories and universities of Europe for one year, beginning on September 1. During his absence Dr. M. A. Tuve, also of the department of terrestrial magnetism, will carry on the high-potential and conducting-layer experimental work, with the assistance of Dr. R. E. Gaviola and L. R. Hafstad, who have been appointed associate physicist and assistant physicist, respectively, for one year.

DR. CARL A. L. BINGER, associate member of the Rockefeller Institute for Medical Research, has been granted a year's leave of absence for study abroad.

He is at present at the University Medical Clinic in Heidelberg, of which Geheimrat Krehl is the director.

PROFESSOR A. K. LOBECK, of the department of geology of the University of Wisconsin, has returned from a tour abroad, during which he visited thirteen countries.

DR. S. E. LONGWELL, professor of biology in Middlebury College, has recently returned from a sabbatical year which was spent in studying the fauna and flora of Australia, New Zealand and Tasmania.

DR. ALEXANDER VYSSOTSKY, of the Leander McCormick Observatory, is paying a visit of several weeks to the Harvard Observatory. He is engaged in securing with the 24-inch reflector the spectra of faint stars, of which he has measured the proper motions at Leander McCormick. Dr. Leon Hufnagel is spending the next few months in the study of spectrophotometry at the observatory.

A COMMITTEE of ten Americans who, at the invitation of a German committee representing agriculture, industry and finance, were selected to work with a committee of Germans in a study during the summer of 1928 of the marketing of farm products in Germany, particularly dairy products and meats, has now returned to the United States. Dr. George F. Warren, of Cornell University, was chairman of the American commission. The other members were J. Clyde Marquis, of the bureau of agricultural economics, of the U. S. Department of Agriculture; Director F. B. Morrison, of the New York State and Cornell Experiment Stations; Dean and Director H. W. Mumford, of the Illinois University and Station; Dr. F. A. Pearson, H. A. Ross and Otto Rahn, of Cornell University, and G. E. Gray, Dr. N. W. Hepburn and I. C. Weld, representing commercial interests. This survey included a thirty-day trip through the principal agricultural regions of Germany, on which more than 5,000 miles were traveled by rail and automobile. The commission was given a most favorable opportunity to observe conditions at first hand.

DR. GRAHAM LUSK, professor of physiology in the Cornell University Medical College, gave an address on October 12 at the eighty-second anniversary of "Ether Day" at the Massachusetts General Hospital, Boston.

PROFESSOR E. L. THORNDIKE, of Teachers College, Columbia University, will give twelve lectures on the Messenger Foundation of Cornell University. The subject of his lectures will be "The General Field of Psychology." The Messenger Lectures were established at Cornell University in 1923 as a memorial to the late Hiram J. Messenger.

DR. WILLIAM K. GREGORY, professor of paleontology in Columbia University, will read a paper on "The Upright Posture of Man: its Origin and Evolution," at a meeting of the American Philosophical Society of Philadelphia on November 2, at 8:15 in the evening.

DR. WILLARD ROUSE JILLSON, director and state geologist of the Kentucky Geological Survey, is giving a course of lectures on the "Geology of Kentucky" at the University of Kentucky, Lexington. The lectures will occupy the entire fall semester of 1928 and 1929.

DR. HOWARD C. TAYLOR, president of the American Society for the Control of Cancer; Dr. Burton J. Lee, New York, and Dr. Channing C. Simmons, Boston, were the speakers at a symposium on cancer which was held at Bridgeport, Connecticut, on October 16.

DR. WALTER R. MILES, professor of experimental psychology, Stanford University, will give the first annual series of three Benton W. Colver Lectures under the auspices of the College of Medical Evangelists, Los Angeles, California. The general subject announced is: "The Psycho-biologic Investigation of Drugs"; November 13, "Animal Learning and the Psycho-bioassay of Drugs"; November 14, "Important Drugs Weighed on the Behavior-balance"; November 15, "Dilute Alcoholic Beverages and Human Behavior."

ACCORDING to the *Journal* of the American Medical Association the anniversary of Sir William Osler's birthday was kept in London on July 12, by the Osler Club for the Study of the History of Medicine. Sir Wilmot P. Herringham, delivering the first Oslerian oration, gave a sketch of Osler as clinician, man and bibliophile. Sir Humphry Rolleston spoke of Osler as a human being. This was followed by an Osler symposium, with short papers by Sir Squire Sprigge, Dr. Franklin Martin, Sir Walter Fletcher, Professor Fraser-Harris, Dr. Harold Scott, Dr. Andrew Balfour, Dr. John D. Rolleston and Dr. Ernest Jones. There was an exhibition of a selection of Sir William's writings, scientific and literary, of books inspired by him, of biographic appreciations, and of his favorite books—the Religio Medici, The Anatomy of Melancholy and Letters de Gui Patin.

A STATUE of Louis Pasteur, near the west end of the Field Museum, Chicago, will be dedicated on October 27, at 3 P. M. The French ambassador to the United States will make a brief address and the French Choral Society will sing. In the evening, the Pasteur Memorial Committee will give a banquet at the Drake Hotel in honor of the ambassador. Dr. Frank Billings is chairman of the Memorial Committee.

DR. HARRIS MILLER BENEDICT, professor of botany in the University of Cincinnati, and his daughter, a freshman at the university, were killed in an automobile accident on October 17. Professor Benedict was fifty-five years old. He had been president of the Ohio Academy of Science and was a representative of the American Society of Plant Physiologists on the council of the American Association for the Advancement of Science.

DR. E. A. SCHWARZ, the well-known beetle specialist of the Bureau of Entomology, who retired several years ago, died on October 15. On the afternoon of the sixteenth a memorial meeting was held in the museum and several of the older entomologists spoke appreciatively of his life and work.

Nature reports, on September 27, at the age of eighty-three years, the death of Sir Henry Wickham, who succeeded in obtaining seeds of *Hevea* from the Upper Amazon which were successfully grown at Kew and distributed in the East, thus starting the plantation rubber industry.

DR. ROBERT KNOX, president of the British Röntgen Society, died on September 21 at the age of sixty years.

DR. JEAN BRETHES, entomologist of the Museum of Natural History at Buenos Aires, died on July 2.

THE one hundred and eighty-seventh meeting of the Columbus Section of the American Chemical Society was held in the new chemistry building at the Ohio State University on October 15. The speaker of the evening was Dr. Orland R. Sweeney, head of the department of engineering chemistry at the Iowa State College. His subject was: "The Commercial Utilization of Corn Stalks and Corn Cobs." Dr. Sweeney reviewed the present economic situation in agriculture and told of the research work now in progress to utilize the yearly waste of over a billion tons of crop residues. It was followed by a demonstration of the new Kodacolor process by Mr. Frank Haskett, of the department of architecture of the Ohio State University.

AN intersectional meeting of the Eastern New York, Cornell, Rochester, Western New York and Syracuse Sections of the American Chemical Society was held at Syracuse University on October 19 and 20, at which a symposium was held on the organization of industrial research and a discussion on cellulose. Among those taking part in the symposium were Dr. C. E. Kenneth Mees, of the Eastman Kodak Company; Charles M. A. Stine, of the du Pont Company; Professor John Johnston, of Yale University; Dr. W. R. Whitney, of the General Electric Company, and Thomas Midgley, Jr., of Dayton, Ohio.

A PUBLIC health congress and exhibition to be held in London in November is noted in the *Journal* of the American Medical Association. Addresses will be given by Sir George Newman, chief medical officer of the ministry of health and board of education, on the purpose of the public health services; by Sir Walter Fletcher, secretary of the Medical Research Council; by Mr. E. D. Simon, formerly lord mayor of Manchester, on housing; by Mr. Wilfred Buckley, a member of the milk advisory board, on the production and distribution of wholesome milk, and by Dr. W. M. Willoughby, health officer of the city of London, on food protection from the national and domestic standpoints. Water supply and sewerage, the construction and equipment of hospitals and town cleansing are other subjects to be discussed. The congress will last for a week.

A DINNER of the Engineering Foundation in New York City on October 19 marked the opening of a campaign to collect $7,000,000 for the work of the institute. Of the total sum to be raised, $2,000,000 is sought to advance scientific research under the auspices of the foundation and the rest is needed to add to the library of the Engineering Societies Building, at 29 West Thirty-ninth Street. Dr. Charles H. Herty, adviser to the Chemical Foundation, Inc., called for the establishment of a Cellulose Institute to be financed jointly by the lumber, cotton textile and paper institutes. Others who spoke were Marston T. Bogert, professor of chemistry at Columbia University, and Ambrose Swasey, of Cleveland, founder of the Engineering Foundation.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $20,000 as a fund for fellowships or scholarships has been made to the Yale School of Forestry by Mrs. William H. Sage, of Albany, New York. The fund has been given as a memorial to William Henry Sage, a graduate of Yale College in the class of 1865. Before his death Mr. Sage provided a fund of $300,000 for the erection of a building for the School of Forestry, in memory of his son, DeWitt Linn Sage, Yale, '97.

THE new agricultural hall at Berea College, made possible by a gift of $45,000 from Dr. and Mrs. Joel E. Goldthwait, of Boston, was dedicated on October 18.

DR. C. T. DOWELL, formerly dean of the school of agriculture of the Oklahoma College and director of the Oklahoma Station, has been appointed dean of

the College of Agriculture and director of the stations of Louisiana University. He took up his new work in August, succeeding Dr. W. R. Dodson, whose resignation has been previously noted.

New appointments announced by the University of Chicago board of trustees include that of Thomas Griffith Taylor, now head of the department of geography in the University of Sydney, Australia, as professor in the department of geography. Dr. William Robinson has been appointed assistant professor in the department of pathology under the Otho S. A. Sprague Memorial Institute. Promotions include that of Ernest P. Lane to a professorship in the department of mathematics.

Dr. Sherman C. Bishop has resigned as New York State zoologist to accept a position in the University of Rochester.

DISCUSSION AND CORRESPONDENCE

THE CONSERVATION OF INTELLECT

Professor Williams[1] has indicated a very important problem which has a marked bearing on the future of scientific research in America. He notes that many students borrow money to enable them to complete their college course and that under that handicap of debt they can not go on to graduate study without having the financial assistance of a university fellowship or assistantship.

Professor Williams points out that there are all too few fellowships available and that a routine assistantship offers far from ideal environment for fostering creative scholarship. Accordingly he suggests:

> If funds were available to finance a group of fellowships for this class of men, as has been done by the National Research Council for the men who have just taken their doctorate, I believe help in fostering research work would be applied at the most strategical period in the career of a young researcher. At present there are not enough graduate assistantships to take care of all those who desire to do graduate work. These additional fellowships would add greatly to the opportunities for advanced work which the assistantships now partially supply.

I wish to add a fervent "Amen!" to Professor Williams' plea. The entire department of agriculture of the University of Minnesota has available each year *three* fellowships, each carrying a $500 stipend and exemption from university tuition. There are approximately 250 graduate students majoring in the various fields of agricultural science at Minnesota. Each year from forty to fifty applications for the three available fellowships pass through my hands in my capacity as chairman of the Graduate Group Committee for Agriculture. In the past five years applications for these three fellowships have been received from nearly every state in the Union and from several foreign countries.

It is the task of this committee to decide which three of the applicants shall receive the awards.

Each year every member of the committee goes away "heart-sick" from the meeting at which the awards are decided. Time and again we read on the application blank the aspirations of the student to begin or continue graduate work, ending with the plea that such aspirations can not be realized unless some small income is assured.

In a group of fifty applications it is a relatively easy task to select twenty-five which have definitely inferior credentials as compared with the other twenty-five. This does not mean that the lower group is not of graduate caliber but rather that they do not appear from the evidence available to be definitely superior. Accordingly this group is eliminated from further consideration.

Then comes the task of selecting within the upper group. Here again we can choose with less certainty a group of ten or twelve who appear to show more promise or who have had more basic science courses than the others. The choice here is fraught with a much greater probability of error than the first selection process.

Now comes the task of selecting *three* from the outstanding ten or twelve! Frankly, it can't be done—except by casting lots, and that is what occurs every year. All the students in this upper group should go on for graduate study. All have promise of a brilliant future. Only three can receive fellowships, and to my own knowledge some students in this upper group, but whose fate, as luck would have it, was to be denied the fellowship stipend, are now teaching in high schools or working at various tasks in industrial laboratories in order to live and pay the accumulated debt, when in justice to ourselves as a cultural nation they ought to be either candidates for the doctor of philosophy degree, or, having received that degree, ought to be in professors' chairs blazing new paths for others to follow.

No greater problem of *conservation of national resources* faces the American people than the conservation of intellects which are allowed to atrophy because of the stultifying influence of routine drudgery which comes to many who have chosen the path of science as undergraduates, only to find that the doors of advancement are locked to those who do not have the higher training represented by post-graduate

[1] Science, 68, 244–5, 1928.

work and whose financial resources are so limited that they can not reach the goal toward which they started.

May I add here that I am not appealing for fellowships in any particular branch of science but for *fellowships available in any field of science.* Too often when a fellowship is available only for chemistry, the recipient may be inferior in potential ability to some one who aspires to be a physicist when no fellowship is available in that field. Neither am I appealing necessarily for fellowships at Minnesota, for the student should be permitted to select the *men* under whom he wishes to work and not be limited to a university which will grant an assistantship permitting work toward a Ph.D. degree, for, after all, graduate schools are known by their works, by the *men* on the faculty and not by the name of the university or by the ornateness of the buildings. There may be only one man in America who stands preeminent in the field in which the student wishes to do major work, in which case the fellowship should permit the student to work with this man rather than waste his time on a second-rate instructor in another university where a fellowship happens to be available.

The Graduate Group Committee for Agriculture at Minnesota awards the three available fellowships, as nearly as is possible, solely on the basis of merit of the individual and not on the basis of departments. Such a committee having similar duties could well function in our sister institutions and would be a necessity in the event that additional funds for any considerable number of fellowships became available.

In closing may I add that while I rejoice at the increasing number of $1,500 to $2,500 fellowships which are being provided for *post-doctorate* fellowships, nevertheless I can not help wondering whether *five* $500 post-baccalaureate fellowships, to assist talented students to begin post-graduate work, might not yield greater scientific dividends than does a single $2,500 post-doctorate fellowship. In any event, I'd like to see the experiment tried, for I believe I can predict the results.

ROSS AIKEN GORTNER
UNIVERSITY OF MINNESOTA

CONE-IN-CONE ON CONCRETIONS FROM THE DEVONIAN OF NEW YORK

THE fact that the concretions occurring in the Devonian of New York[1] contain a well-preserved fauna and flora is in keeping with similar occurrences both in this country and abroad. This feature of fossiliferous concretions was pointed out in my article on concretions in the "Treatise on Sedimentations" (p. 514).

Mr. Alexander notes that some of these concretions have "the peculiar cone-in-cone structure *for which no explanation has as yet been offered.*"[2]

I should like to call Mr. Alexander's attention to the fact that the occurrence of cone-in-cone on and in concretions is mentioned in the article referred to above (p. 502), and that the origin of this interesting structure is discussed in an article on cone-in-cone in the same volume (pp. 515–518). The origin is discussed in more detail in my paper on "Cone-in-Cone," in volume 4 of the *American Journal of Science* (pp. 199–213), where there is also another list of references in addition to those on page 515 of the "Treatise on Sedimentations." I think Mr. Alexander will find that an explanation for this structure has been offered.

Attention should also be called to the statement: "In the marcasite nodules, the iron pyrite has replaced the organic, as the case may be, by its silver white metal." It is not "iron pyrite" (for pyrite is a mineral separate and distinct from marcasite), but *iron disulphide,* that has replaced the organic material.

W. A. TARR
UNIVERSITY OF MISSOURI

WINTER ROOT GROWTH OF PLANTS

IN a series of investigations at the Boyce Thompson Southwestern Arboretum, it has been found that the roots of certain plants, generally thought to be dormant in winter, make definite, continuous growth at this season. This is true of both deciduous and evergreen species and embraces cultivated and wild forms. Notable examples are *Prunus persica, Prunus armeniaca, Covillea tridentata, Simmondsia californica, Cupressus arizonica* and *Opuntia laevis.* The rate of root elongation per day, of the species under observation, was found to vary from 9 mm in November, as the maximum, to .5 mm in February, as the minimum. Growth was evidently affected by change in the seasonal temperature of the soil, but there appeared to be no direct or close correlation between daily growth and soil temperature.

In the study of individual species the average daily root elongation of the peach (*Prunus persica*), covering the winter period between November 4, 1927, and March 31, 1928, was 2.10 mm. The average daily growth for November was 5.55 mm, December 2.01 mm, January 1.65 mm, February .90 mm, and March 1.16 mm.

In contrast to this group of plants showing decided growth in winter, other plants were found which, under the same environmental conditions, make no

[1] A. Emil Alexander, "Devonian Concretions of Western and Central New York," SCIENCE, 68: 85, 1928.

[2] Italics mine. W. A. T.

root growth whatever at this season. Among these are *Citrus aurantium, Vitis vinifera, Prosopis velutina* and *Parkinsonia torreyana.* The period of root inactivity begins about the first of December and lasts until the latter part of March.

These observations were made by growing the plants in large wooden and cement boxes provided with plate-glass front, which made it possible for the roots to be easily seen and checked each day. Light was excluded by a well-insulated door, easily opened and closed. The boxes were made in two series, the smaller three by three feet square and holding twenty-seven cubic feet of soil, and the larger six by six feet square and holding 216 cubic feet of soil. The amount of soil in the latter case was sufficient to accommodate a tree, such as the peach or orange, for four or five years.

F. J. CRIDER

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AN UNEXPLAINED VISUAL PHENOMENON

THE following note is written at the suggestion of Professor J. P. C. Southall, of the Department of Physics of Columbia University, in the hope that some of your readers may be able to explain an observation that I made the other day. While coming down from Minneapolis with the Air Mail, I happened to notice that the propeller became visible upon turning the visual axes of my eyes laterally. The conditions of observation were as follows: I was seated in a cabin plane, about eight feet behind the propeller and about eighteen inches lateral to the median line of the plane. About half way between my seat and the propeller was an inclined windshield, forming a lateral angle with my visual axis of about 60° and a vertical angle of about 80°.

A setting sun was directly behind the tail so that no direct rays from the sun fell either into the cabin or upon the propeller. There was smooth air at about 2,500 feet with practically no lateral motion. The tachometer reading of propeller revolutions swung between 1,650 and 1,675 revolutions per minute.

The propeller was of white metal, about eight inches wide where it first became visible above the top of the cowl and tapered to four inches at the tip, which was about two feet beyond the point of the cowl line. It was a two-bladed propeller.

The observations were made with each eye alone and then with both eyes together without any variation being found. When the eye was in the primary position and the visual axis parallel to the axis of the plane, the propeller was absolutely invisible and there was not even a blur in the line of vision. As the visual axis was turned laterally (either right or left made no difference), a blur corresponding to the arc of the propeller became visible. Upon increasing the angle, there could be distinguished within the blur the general outline of the individual propeller blades in terrifically rapid motion. These were clearest at about 45° from the primary position. As the angle was increased still more, the individuality of the blades moved into a blur corresponding with that seen at first. At about 60°, the blur was entirely lost. It seemed that for about 10°, namely, between 40° and 50°, the blades were seen as individual, and for about 10° to either side of these limits, the blades were seen as a blur. These figures are of course approximate, as I had no means of determining the angles accurately. When the accommodation of the eye was relaxed by fixing upon objects in the landscape a mile or more away from the plane, the phenomenon was much more apparent than when the eye was accommodated for points upon the plane three to ten feet away.

I must confess that I am entirely at a loss to explain the observation and would appreciate any possible explanation.

HARRY S. GRADLE

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THE MEASUREMENT OF ULTRA-VIOLET RAYS

DR. OTTO GLASSER has taken it upon himself in the issue of SCIENCE for August 3, 1928, to criticize the report by Science Service printed in the same journal for May 11, 1928, of devices for the measurement of ultra-violet rays described by us. While we are not responsible for the text of the report criticized and while no explanation of such a criticism is necessary to any one familiar with the field, we should like to make the following statement. The note in SCIENCE is a report of a paper read before the American Roentgen Ray Society in Montreal, on September 27, 1927, and published in the February issue, 1928 (Vol. 19, p. 144) of the *American Journal of Roentgenology and Radium Therapy,* that is, three months before the report appeared in the May number of SCIENCE. In the original paper full credit is given to all previous workers and a more complete bibliography than is mentioned by Glasser is published. A marked reprint of our paper has been filed with the editor of SCIENCE. Since the original paper is known to all workers in the field and since the note in SCIENCE is merely consistent with all others there published in not giving references and bibliography, Mr. Glasser's criticism is incomprehensible to us.

ERNST A. POHLE,
WALTER S. HUXFORD

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SCIENTIFIC BOOKS

Die Geschlechtschromosomen. Zellen- und Befruchtungslehre, FRANZ SCHRADER. Borntraeger, Berlin, 1928.

IN the compass of 194 pages Professor Schrader has given a summary in English of the present status of the sex chromosomes. The book gives from first-hand knowledge a judicious summing up of the literature, both from the cytological and genetic point of view, especially the former. The historical background of the various advances in our knowledge of the sex chromosomes is carefully considered. The extensive material, which might so easily make only a dull summary, has not only been carefully catalogued, but the important points have been emphasized and discussed under their respective headings. There is, for instance, an introduction to the whole subject of about sixty pages, covering most of the problems under consideration to-day. This is followed by a systematic review of the sex chromosomes, considered from the point of view of the larger groups of the animal kingdom. Each minor section is introduced by a brief critical discussion, in which the author does not hesitate to express his opinion in regard to the individual contributions. A treatment of this sort, when unprejudiced and cautious, makes the reading more interesting and valuable than if no such discrimination were attempted. A brief summary of the recent results relating to sex chromosomes in plants is added. A sufficient bibliography follows. The latter will be useful in following up the references in the text, although it is difficult to disentangle the literature dealing with the sex chromosomes from the remainder of the literature of cytology.

Never before in the history of the subject has there been so much activity shown in the study of the number of the chromosomes, especially in plants. Scarcely a week goes by without one or more papers in the journals giving new counts. Most of these papers deal only with the number of chromosomes in a given group and are, therefore, purely descriptive. Nevertheless, they are useful in bringing to light suitable material for genetic work. The part played by chromosome changes in many of our cultivated varieties of plants has aroused widespread interest. Schrader's summary will be very helpful to students of this new literature who wish to keep in contact with the historical development of the subject. His familiarity both with the cytological and genetic evidence greatly enhances the value of his review.

T. H. M.

Foraminifera. Their Classification and Economic Use. By JOSEPH A. CUSHMAN. Sharon, Mass., Special publication No. 1, Cushman Laboratory for Foraminiferal Research, 401 pp., 59 plates, 1928.

THIS is the most comprehensive review of the Foraminifera that has appeared in modern times. It is largely devoted to the systematic treatment of the genera of this protean group, but there are special chapters devoted to more general subjects, such as "The Living Animal," "The Test," "Collecting and Preparing Material," "Methods of Study," "Geographic and Geologic Distribution," and "Economic Uses."

The author recognizes 411 valid genera of these shelled protozoans and cites in addition 196 synonyms. Many of the genera are based upon old species inadequately described in the early works of last century, and Dr. Cushman has, therefore, taken the pains to go abroad and reexamine the type specimens for the great majority of all these genera. Consequently, his results have a security that could have been attained in no other way.

In the treatment of each genus its genotype is given, the common synonyms indicated and a brief generic diagnosis is supplemented by an illustration of either the type specimens of the genotype or of some other species especially selected to show the generic characters. The excellent enlarged drawings of these specimens are arranged on fifty-nine full-page plates conveniently distributed through the text.

The present handsome volume is the fruition of the promise given about a year ago in the same author's "Outline of a Reclassification of the Foraminifera." The remarkable progress that Dr. Cushman has made in the systematic arrangement of the Foraminifera is only suggested by his discrimination of forty-five families instead of the ten recognized by previous students. Throughout these families the relationships have been established by a study of the ontogeny of microspheric forms, checked by the chronology of fossil species. The result has been the detection of the repeated development of remarkable homeomorphy and the necessity for the realignment of many species and genera. These and other modifications of shell form are very clearly brought out in a series of illustrated charts which show the mutual relationships of the several genera in each family. There is, in addition, a summary chart showing the interrelations of the forty-five families of the order. The extensive, but selected, bibliography occupying thirty pages of text will be a great aid to all students of the Foraminifera.

The confusion of names and the uncertainty of many generic characters had become a serious obstacle to any general studies in this vast group. Dr. Cushman's investigations have been so comprehensive and his findings so clearly marshalled that this last great work will be a point of departure for all future studies in the Foraminifera.

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Thomas Condon, Pioneer Geologist of Oregon. By ELLEN CONDON MCCORNACK. University Press, Eugene, Oregon, 1928.

PROFESSOR CONDON was an outstanding and singularly attractive figure in the history of Western geology. He came as a missionary to Oregon in its early days in 1852. Interested from the first in the geology and fossils of the new country, he became more and more a leader and teacher in the science, and when the University of Oregon was organized in 1876 he was appointed to the chair of natural science at Eugene, and spent a long and active life in exploring, collecting, teaching and lecturing. He lived to see the pioneer community in which he had settled grow into a great and prosperous state, to see the new localities and fossils that he had discovered and brought to the notice of Eastern scientists become classic fields and well-known faunas, and the successive generations of students that he taught step forward into active useful life inspired by the fine enthusiasm and love of science that pervaded his life and teaching.

The correspondence with the Smithsonian Institution, with Marsh, Cope and others regarding Condon's discoveries, reveals an exceptionally fine and generous attitude on his part and may well serve as an inspiration to those of us who hope to follow his lead. A brief sketch of his life and principal discoveries, citations from some of his early essays and reports and an outline of the fossil mammal faunas of central Oregon are also included. An appreciative foreword by Henry Fairfield Osborn precedes the account.

W. D. MATTHEW

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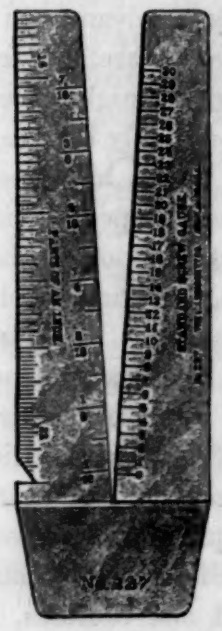
SCIENTIFIC APPARATUS AND LABORATORY METHODS

A GAUGE FOR RAPID DIAMETER MEASUREMENTS

FACED with the problem of measuring the diameter of several thousand fruit tree seedlings rapidly at a point just above the surface of the soil, the writer came upon a screw and wire gauge which met the requirements nicely, information about which he passes along to any others who may have similar problems to meet. The accompanying figure explains itself. The gauge is of spring tempered steel about four inches long and one and one-half inches wide, easily carried in the pocket. The gentle slope of the sides makes it possible to measure diameters with surprising accuracy. The markings in parts of an inch read in thirty-seconds of an inch, and in actual operation it is not difficult to read in sixty-fourths. The maximum diameter accommodated is seven sixteenths of an inch.



A second scale for measuring the outside diameter of screw threads offers further refinement. Reading from 0 to 30, they represent the following decimal equivalents of an inch:

No. 0—0.060	No. 10—.190
No. 1— .073	No. 12—.216
No. 2— .086	No. 14—.242
No. 3— .099	No. 16—.268
No. 4— .112	No. 18—.294
No. 5— .125	No. 20—.320
No. 6— .138	No. 22—.346
No. 7— .151	No. 24—.372
No. 8— .164	No. 26—.398
No. 9— .177	No. 28—.424
	No. 30—.450

In operation this gauge has been found superior to slide micrometers, both in accuracy and rapidity of measurement.

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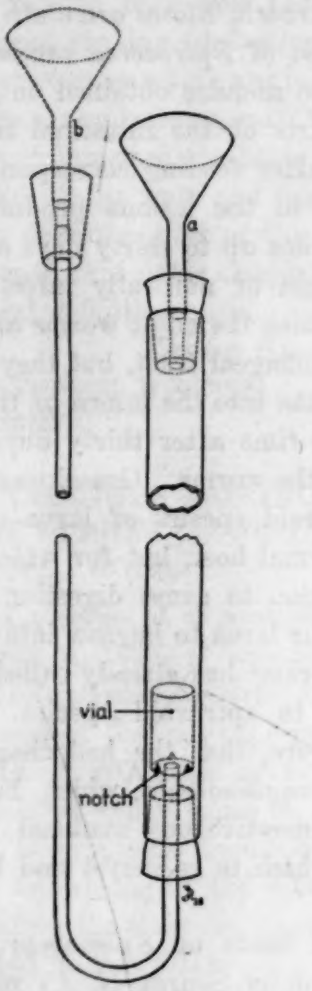
A SIMPLE FIXING, WASHING AND DEHYDRATING DEVICE

THE dehydrating device described by W. D. Courtney in SCIENCE for June 29, 1928 (p. 653) suggests

a simpler apparatus that I have used in the zoological department of the University of Texas for a number of years. This embodies the principle of Courtney's device for dehydration, namely, that alcohol, being lighter than water, is admitted from below.



The apparatus is illustrated in the accompanying cut. It is made up of strong-walled glass tubing of about 18 mm bore, fitted in the bottom with a fresh one-hole rubber stopper. Through this is run a thin glass tubing bent up as shown in the illustration. The narrow glass tube should somewhat overtop the larger one. The objects to be treated are placed in "baskets" consisting of short shell vials about 15 mm in outside diameter, each provided with two or three holes ground in the bottom to insure diffusion of fluids. The holes can be ground very readily *under water* by means of a sharp-edged carborundum stone. In the grinding operation the stone is guided by the tips of the thumb and index finger, which should be protected against abrasion by strips of adhesive tape. If the objects are smaller than the holes, these may be closed with small tufts of cotton. A label is added to each "basket"; with a little care the mixing of labels is entirely avoided. After dehydration is completed, the baskets with their contents are readily dropped into a dish of alcohol.

For economy of reagents it is well to have tubes of a half-dozen different lengths, say six, eight, ten, twelve, fifteen, eighteen inches, and a couple of dozen "baskets" to accommodate a variable number of specimens assembled at any one time.

For washing, a funnel with stem pushed half way into a suitable one-hole rubber stopper, is placed in position *a* of the illustration. Tap water may be run through without unduly shaking delicate specimens, an advantage over the Kornhauser apparatus (SCIENCE, March 27, 1924, p. 464). For dehydration the funnel is changed to position *b* (dotted lines), since alcohol must enter from the bottom.

Dehydration may be as gradual as desired. To control the rate of addition of alcohol I have utilized Long's capillary siphon method.[1] Siphons are prepared by drawing out glass tubing to capillary fineness; these are then calibrated. Thus with the appropriate siphon one can regulate the flow of alcohol so that dehydration will be completed in a couple of hours or a couple of weeks.

With no more handling of the objects, the apparatus may be used for fixing and mordanting as well as washing and dehydrating—one fluid is allowed to run out and the next is run in, changes that require only a few seconds.

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SPECIAL ARTICLES

THE LIFE CYCLE OF SPIROCERCA SANGUINOLENTA—A NATURAL NEMATODE PARASITE OF THE DOG

IN an earlier study[1] the writer found that mature third-stage larvae of *Spirocerca sanguinolenta* were commonly encysted in the mesentery and omentum and on the parietal wall of the stomach and adjacent intestine of the Asiatic hedgehog, *Erinaceus dealbatus*, and that these larvae, when fed to experimental puppies and kittens, excysted in the stomach of these animals, penetrated the stomach wall, passed through the gastro-epiploic veins into the portal circulation, thence *via* the capillaries of the liver and lungs into the left heart, and upon reaching the aorta became attached to the intima and burrowed into the aortic wall, where they produced extensive lesions. In view, however, of the fact that this infection occurs natu-

[1] J. A. Long, *Anat. Rec.*, 29: 319, 1925.

[1] E. C. Faust, "Migration Route of *Spirocerca sanguinolenta* in its Definitive Host," *Proc. Soc. Exp. Biol. Med.*, 25: 192–195, 1927.

rally in dogs in areas in which the hedgehog is not present, it seemed necessary to assume that the dog may become naturally infected from some other source.

The family relationship of this nematode, as well as the morphological studies of Seurat,[2] suggest that certain insects which harbor the encysted larvae are the most likely source of this infection for dogs. In fact, Grassi[3] believed that he was dealing with this species when he fed dogs encysted nematode larvae obtained from the cockroach, *Blatta orientalis,* and on autopsy five to fifteen days later found spiruroid larvae embedded in the wall of the stomach and small intestine. The writer's experience has, however, shown that the true *Spirocerca* larvae pass directly through the stomach wall almost immediately after excystment, and between the fifth and thirtieth days are all to be found attached to or embedded in the wall of the aorta and its immediate offshoots. Furthermore, examination of hundreds of cockroaches of several species in heavily infected foci in Peking and Amoy, China, has failed to reveal any larvae of *Spirocerca sanguinolenta* in these insects, although several specimens of other spiruroid larvae have been obtained (Amoy). Likewise, controlled feeding experiments in Peking, in which mature eggs of *S. sanguinolenta* from esophageal tumors in dogs were fed to *Blatta orientalis, Periplanata americana* and *P. australasiae,* have always given negative results. More recently (April, 1928) thirteen specimens of the dung beetle, *Canthon* sp., were obtained from an area near Peking from which heavily infected hedgehogs had been commonly obtained. On dissection five of these beetles were found to harbor in the thoracic and adjacent leg muscles a relatively heavy infestation of larvae morphologically indistinguishable from those of *S. sanguinolenta.* These were fed to a dog born and reared in the laboratory. Twelve days later the dog was autopsied. Examination showed all organs to be negative except the aorta, which contained serpiginous tunnels in the intima and aneurisms in the wall characteristic of early infections with *S. sanguinolenta.* Larvae were also recovered from the tunnel as well as from the deeper layers of the aortic wall, and corresponded in every detail to the larvae fed.

The series of examinations as well as experimental evidence strongly favor the view that the first intermediate host of *Spirocerca sanguinolenta,* at least in North China, is a beetle, *Canthon* sp., while neither dissections nor experimental evidence provide any grounds for believing that cockroaches in China serve in this capacity. Furthermore, it seems altogether probable that the larvae which Grassi (*l. c.*) obtained from the cockroach, *Blatta orientalis,* and fed to dogs, were not those of *Spirocerca sanguinolenta.* In the first place, the nodules obtained on the stomach wall and other parts of the intestinal tract from five to fifteen days after feeding correspond neither in type nor position to the lesions produced by larvae of *S. sanguinolenta* up to thirty days after feeding. In the later stages of naturally infected dogs, nodular growths in which the adult worms are found do occur along the esophageal tract, but they are for the most part outgrowths into the lumen of the esophagus, and develop some time after thirty days' incubation and migration of the worms. Grassi was probably dealing with a spiruroid species of larva of which the dog was an abnormal host, but for which there was sufficient adaptation to cause digestion of the cyst wall and permit the larva to burrow into the wall, there to re-encyst. Cram[4] has already called attention to this phenomenon in spiruroid species. It is altogether likely, therefore, that the hedgehog is an abnormal host for *S. sanguinolenta,* which, however, is able to utilize this insectivorous mammal as a satisfactory medium in which to re-encyst and live almost indefinitely.

The larval hosts of *Spirocerca sanguinolenta* in Algeria, listed by Seurat (*l. c.*) purely on morphological grounds, include six species of coprophagous beetles, and a large number of amphibians, reptiles, birds and mammals. These should be divided into two categories, the one comprising dung beetles and possibly other coprophagous insects, constituting the primary (true) intermediate hosts; and the other, including all insectivorous and omnivorous vertebrates, in which the larvae, failing to pass through into the blood stream, become "side-tracked" and encyst in or on the various abdominal viscera. These latter are secondary (reservoir) intermediate hosts. Their importance as a source of infection for dogs is probably considerable, since the larvae appear to remain viable in these secondary intermediate hosts for long periods of time and even increase in size there, and since these hosts are more commonly eaten by dogs than are coprophagous beetles.

Finally, reference should be made to the cat, which is not known to be a natural host of this nematode but which serves as an excellent experimental animal for tracing the migration route during the early stages

[2] L.-G. Seurat, "Formes Larvaires des Nématodes Parasites Hetéroxenes," *Bull. Soc. Sci. France et Belge,* ser. 7, 49: 297–377, 1916.

[3] B. Grassi, "Beiträge zur Kenntniss des Entwicklungscyclus von fünf Parasiten des Hundes," *Centralbl. Bakt. Parasitenk.,* 4: 614–615, 1888.

[4] E. B. Cram, *Journ. Parasitol.,* 11: 117, 1924.

of the infection. The primary lesions in the aortic wall of the cat are, however, much less intense than they are in the dog, and it seems not unlikely that in the cat the infection becomes abortive before the worms are able to mature.

The complete life cycle of *Spirocerca sanguinolenta*, therefore, needs include only two hosts, the insect (primary larval) and the dog (definitive), although a wide variety of vertebrates which are insectivorous or which ingest insects accidentally may become intercalated as reservoir intermediate hosts in the cycle. With the exception of the wolf and the fox, the dog is the only known definitive host of this worm. It is not unlikely, however, that other Canidae may also be found to be natural definitive hosts.

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VISCOSITY CHANGES DURING EARLY CLEAVAGE STAGES OF FUNDULUS EGGS

IN the course of a series of experiments carried on during the summer of 1927, it was noted that the removal of the protoplasmic material of one of the first two blastomeres of the egg of *Fundulus heteroclitus* is accomplished with little or no difficulty at certain times, while at other times it is practically impossible. The observations made on this point contribute to our knowledge of the relative viscosity of protoplasm[1] during the cleavage stages and should, I think, be reported in this place.

As is well known, the egg of Fundulus is relatively large and the first two blastomeres may very easily be seen under even the low power of the binocular dissecting microscope. Being large, the blastomeres of the early cleavage stages contain a considerable amount of protoplasm which bulges within the chorion. It was the purpose of the experiments to remove all the protoplasm of one of the first two blastomeres. This was found to be quite possible during the period commencing shortly after the completion of the first cleavage furrow and ending shortly prior to the formation of the second cleavage plane. Before and after these stages, it was impossible to remove all the protoplasm of the cell without injury to the other blastomere and without the loss of a considerable amount of yolk. A brief examination of the physical state of the cellular material showed the reason for this.

The experiments were performed with a fine glass needle by means of which one of the blastomeres was punctured, allowing the cytoplasm to flow out. Thus they resemble the microdissection studies carried on in a much more refined way by Chambers and his coworkers. The toughness of the cortical membrane of the fish egg precludes the use of the finer method in these experiments. Nor is it necessary. By means of the microscopically fine glass needle it is possible to puncture one blastomere of the egg in any part and to express the contained cytoplasm. The behavior of the extruded material and the rapidity of the outflow may be directly observed. These give definite information as to the relative viscosity of the protoplasm. Very briefly stated, the results of such tests follow.

A short time before the formation of the first cleavage plane, a puncture with the needle results in the outflow of all the contained protoplasmic material. When examined, it is quite evidently very fluid. This stage is soon replaced by another at which the cytoplasm in the cortical region begins to thicken. This gelation of the cellular material involves not only the actual cortex of the cytoplasmic mound, but also crosses the cell in the region of the future cleavage plane. In this way, the future line of division is foreshadowed even before the margins of the cell have indented. It is probable that the gelation is initiated in this mid-region. The cytoplasm at this time is so stiff in the outer region that the puncture of the cell results only in the extrusion of the medially located cytoplasm. This leaves a hollow shell of relatively rigid cytoplasm in the center of which may be a yolk or water-filled space. In other cases the entire cortex may crumple in. From the cortical area, this stiffening spreads centripetally, accompanying cleavage until both daughter cells show a high relative viscosity throughout. At this stage the removal of all the cytoplasm in one blastomere can not be accomplished without at the same time removing a large amount of yolk and in all probability injuring the sister blastomere.

The gelation effect is almost immediately reversed, so that the protoplasm of the cells again becomes very low in its relative viscosity. It is during this stage that it is expressed most easily, with very little loss of the yolk material, and no deleterious effects to the neighboring cell. The blastomeres remain in this state until just before the second cleavage, when the cortex again stiffens slightly. This is accompanied by a change in the cell itself similar to that found just prior to the first cleavage. The cytoplasm in the region to be occupied by the new line of division also stiffens. This region of higher viscosity is continuous with that of the cortex of the cells. There is every reason to believe that the cycle of changes just described for the so-called resting phases between the first and the second cleavages is repeated between

[1] For literature on this subject see L. V. Heilbrunn, *Quart. Rev. Biol.*, II, p. 230, 1927.

the second and the third, etc. Though the blastomeres become smaller and direct observation more difficult, it is perfectly evident after some experience that the most perfect elimination of the contents of the cells in the early stages may be accomplished after about two thirds of the total time elapsing between the two cleavages concerned has passed.

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MANGANESE AS A FACTOR IN HEMOGLOBIN BUILDING

FOR the past year the authors have been studying the problem of nutritional anemia as produced when whole milk is fed as the sole diet.

Hart and coworkers have reported that the ash of lettuce and cabbage when added to whole milk and iron make a satisfactory diet for hemoglobin building. In our work we have found that the ash of alfalfa and other plants can be utilized in a like manner with almost if not quite as good results.

These facts, together with certain observations and conclusions of Bertrand, McHargue and others, that manganese is essential in plant growth and for the formation of chlorophyl, led us to the study of manganese as a factor in hemoglobin building.

In our experimental work we have attempted to use the rabbit, but with not very great success, due to the fact that the young rabbit when on a deficient diet is so susceptible to coccidiosis and other diseases that our losses have been excessive before we could produce a severe anemia. More recently we have been using the rat for this work as suggested by Waddell, Steinbock, Elvehjem and Hart and find this animal much more satisfactory.

In this preliminary paper we wish to report on the effectiveness of manganese in hemoglobin building, particularly as it affects rabbits. Some forty rabbits have been on this experiment but not all have received a purified diet. Two rabbits made anemic on a whole milk diet were fed five mgs of copper-free iron chloride and 0.5 mgs of copper-free manganese chloride.

Table I shows the hemoglobin content of the blood during the experiment.

TABLE I

Date 1928		Weight	Grams Hemoglobin per 100 cc blood	Diet
Rabbit No. 662				
Jan.	14	375	12.24	Whole milk only
	19	430	12.36	
	27	440	12.24	Added 5 mgs. iron in form of $FeCl_3$
Feb.	8	570	10.20	
	14	655	8.58	
	21			Added 0.5 mgs. manganese + 5 mgs. of iron, the manganese in form of $MnCl_2$
Mar.	12	1010	11.43	
	26	1135	13.26	
Apr.	30	1356	11.43	
May	15	1540	9.09	
June	20	1779	11.22	
July	26	1779	11.22	
Rabbit No. 678				
May	15	556	12.24	Whole milk only
	22	595	10.62	
	28	625	9.59	Added 5 mgs. iron as $FeCl_3$ + 0.5 mgs. manganese as $MnCl_2$
June	8	855	11.22	
	20	944	14.67	
July	9	—	14.60	
	26	1375	12.03	

The results shown above indicate that manganese has a beneficial effect when added to a milk-iron diet.

Manganese apparently exerts the same beneficial effects upon rats as upon rabbits, as is indicated by a number of these animals which we now have on experiment.

In our experimental work we have exercised every precaution to eliminate copper from the ration, since Hart and coworkers have shown this element to be effective in hemoglobin building.

The manganese used was a Baker & Adamson manganese carbonate, C. P. This salt was dissolved in the least quantity of hydrochloric acid, then treated with hydrogen sulphide under pressure for twelve hours. The solution was then filtered and the excess hydrogen sulphide removed by boiling. The iron used was prepared from a very high purity Bureau of Standards iron and treated with hydrogen sulphide to remove any copper.

The milk was handled and kept in aluminum cans and the animals were kept in galvanized wire cages on wire screens. Porcelain mortars were used for feeding dishes.

Further work is being done on this problem of the relation of manganese to hemoglobin building, the results of which will be reported in more detail a little later.

R. W. TITUS
H. W. CAVE

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